DIAMETER GROWTH RHYTHM IN *ACACIA MELANOXYLON* R. BR. ("TASMANIAN BLACKWOOD") AS SHOWN BY DENDROGRAPHIC OBSERVATIONS ON THE WITWATERSRAND.

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Through the kind assistance of the Chief of the Division of Plant Industry, Dr. I. B. Pole Evans, I have been able to investigate growth rhythm phenomena in several species of trees, off and on, during the past nine years, by means of MacDougal's dendrograph. I have published (Phillips 1927; 1931) certain data for Stinkwood (*Ocotea bullata*, E. Mey.) and Hard Pear (*Olinia cymosa*, Thunb.), and desire in this communication to refer to certain phenomena of interest in *Acacia melanoxylon*.

As I have described—in an earlier paper—in some detail (Phillips 1927: 228) MacDougal's dendrograph, and have dealt therein with the physiological phenomena responsible for the diurnal changes in diameter termed "reversible variations", it is my intention to proceed directly to a summarised consideration of certain features of interest in the Blackwood. A fuller treatment of several important relations is reserved for a later paper.

OBSERVATIONS MADE AND THEIR OBJECTS.

Reversible variations in diameter—or volume—of bole, due to changes in water balance in relation to habitat conditions and time of day, have been recorded for a number of North American plants by MacDougal and his associates. They have been shown to occur in several South African trees—notably *Ocotea*, *Olinia cymosa*, and *Acacia caffra*, as the result of my own observations. It was desired to investigate the behaviour of a vigorous, water-voracious *evergreen* species during several years, in a climatic region showing very well marked warm-moist and cold-dry seasons.

Further, the nature of the growth rings—the so-called "annual rings"—exhibited by such a fast-growing *evergreen* in a region with well differentiated warm-moist and cold-dry seasons was a subject I strongly wished to investigate. Investigations carried out by me upon evergreen species in the Knysna forests during the years 1922-1927 failed to clear up the uncertainty regarding growth rings—whether they are *annual* or merely *periodic*—because there is insufficient differentiation, in that region, between so-called summer and so-called winter seasons.

As I required a species readily accessible, as well as one about which a certain amount of physiological-ecological information was known to me from my own researches, I selected the Blackwood. A vigorous pole-stage tree about 30 ft. high, and 6 inches diameter at breast-height, growing in my ecological experimental plots, Crescent Creek, Milner Park, Johannesburg, was selected. This tree had its crown well supplied with light and space, and was rooted in red loam of good depth, and satisfactory physico-chemical nature.

A MacDougal dendrograph was fitted to this tree on December 22nd, 1931, and until January 14th, 1932, was so adjusted that the quartz rod of the recording mechanism was touching the outer and undisturbed surface of the bark. As it was found that heavy downpours of rain were liable to bring about swelling in the bark, the quartz rod from 15th January, 1932 until 18th March 1935, was placed so that it rested against a very thin covering of tissue protecting the living tissues themselves. (*vide* Phillips 1927 : 228.) The rod was set so as to record changes *multiplied by* 20.

Thermograph, hydrograph, evaporation, rainfall, sunshine, photometric and soil temperature data were available from the ecological plots.

During the lengthy course of the observations the tree was in no way disturbed, nor was the habitat altered ; the tree remained vigorous throughout.

PHENOMENA OF INTEREST.

I. *Reversible Variations.*

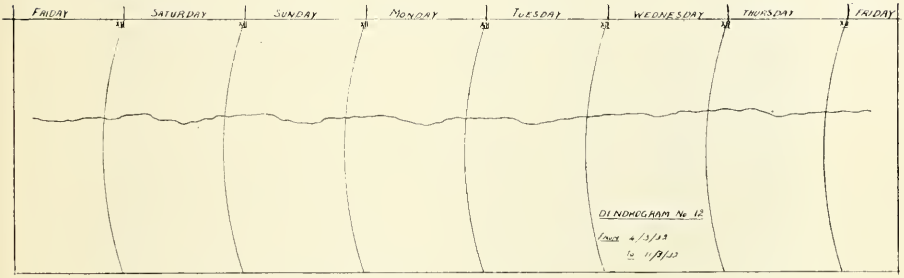
Reversible variations were clearly and consistently shown, throughout the period of 3¼ years, the magnitude of these varying considerably with *season*, and with the particular weather conditions of any given *day*. An example of the variations is given in the *diagram*, for the week beginning March 4th, 1932.

The variations were much more marked in the warm-moist season than in the cold-dry (May-September), becoming very much reduced in the months of June to July, and being somewhat larger in August and September ; from October they appreciably increased. It is interesting, however, to note that during the excessively wet period, November 1st, 1933—April 30th, 1934, the magnitude of the variations, on the whole, was less than in the corresponding seasons of 1932 and 1933. Such variation in magnitude probably is connected with change in root-absorption and transpiration responses and ratio.

On some days in the warm-moist season, a decreased water balance would be indicated as beginning about 7 a.m., and ending about 6 to 8 p.m.; on other days in this season the decreased balance would be indicated as extending over shorter periods, e.g. from 8 a.m. to 6 p.m., according to aerial habitat factors. On days of the cold-dry season, the times of decreased water balance would extend from about 10 or 11 a.m. to about 4 to 5 p.m.

Maximum decrease in water balance usually was registered after 12 noon to 2 p.m., but naturally this depended closely upon the particular rhythm of aerial conditions for the day.

No definite connection between details of the reversible variations and such weather conditions as sudden downpours of rain, or intensely cold, sleety weather (e.g. as experienced in June, 1932) has been observed.



To summarise: Blackwood, an *evergreen* tree transpiring relatively large amounts of water vapour, has been shown to exhibit reversible variations in water balance, throughout the seasons of 3¼ years.

II. *Permanent Increment.*

Without attempting any detailed discussion of the phenomena exhibited so far as permanent increment is concerned, I desire to record the outstanding features:—

(1) As observations commenced on 22nd December, 1931 (above bark) and 15th January 1932 (below bark) respectively, I am unable to state the approximate dates when increment of permanent nature commenced in the season 1931-32. Increment continued until the week ending 27th May. The rainfall during the period 1st November 1931—30th April 1932 was 19·96 inches, on 69 days.

The tree *rested* from about 27th May to about the 18th August, 1932, *a period of a little over 2½ months.*

As is evident from the table of soil temperatures at 1 foot, 2, 3 and 4 feet depths, there was a marked increase in soil temperature from October, 1932 ; this, along with the rainfall, undoubtedly would aid increase in absorption of solutes.

(2) In the season 1932-33, increment of permanent nature commenced about the week beginning the 18th August, 1932, ending in the week terminating on the 27th April, 1933 : the growing season ending, thus, *about one month earlier* than in the season 1931-32. This probably is accounted for by the comparative severity of this season (1932-33), in terms of rainfall and its distribution. The total during the period 1st November, 1932—30th April, 1933, was 16·80 inches only, spread over 62 days—being 3·16 inches less than in the corresponding period for 1931-32. The difference in total rainfall, however, does not fairly represent the differences between the years, in terms of severity for plant life ; the indigenous and exotic flora of the Witwatersrand undoubtedly experienced much more severe conditions in this year than in the year previous. Soil heat was much as in 1931-32.

The tree *rested* from about 27th April to about 30th October, 1933 : *a period of about* 6 *months.*

(3) Increment commenced for the season 1933-34 in the week beginning 30th October, 1933—and, as I have suggested already, this probably is to be accounted for by the severe drought conditions experienced during the period 1st Nov., 1932—30th April, 1933. At all events, increment commenced about 2½ months later than in the year previous (October 30th in 1933 and compared with August 18th in 1932). Increment continued until the week ending 23rd July, 1934 . . . *two months longer than in the season* 1932-33. The rainfall during the period 1st November, 1933—30th April, 1934, was as high as 33·10 inches, on 69 days, the months of November (10·75 inches), December (5.51 inches) and January (11·79 inches) being particularly wet. There is undoubtedly a relation between the heavy rainfall and the extension of the growing season by two months.

The tree *rested* from about the 23rd July, 1934, until the week beginning 17th September, 1934 : *a period of about* 1¾ *months.*

(4) It is seen, therefore, that the *resting* seasons were as follows : in 1932, about 2½ months ; in 1933 about 6 months ; in 1934, about 1¾ months. It is also highly suggestive that the long *resting* period of 1933 is accounted for by the severe drought conditions experienced in the growing season. The very short *resting* period—1¾ months—of 1934 may be accounted for by the higher soil moisture content, for which the heavy rains of the period 1st November, 1933—30th April, 1934, were responsible.

Mean Sub-Soil Temperatures at 8-30 a.m., Several Depths at Roots of Blackwood, Crescent Creek, January 1932—March 1935.

Month.		1 Ft.	2 Ft.	3 Ft.	4 Ft.
1932					
January ..	Growth period	67·57	67·30	66·00	65·00
February ..		66·33	66·05	65·21	64·76
March ..		63·32	63·79	63·77	63·71
April ..		59·35	60·83	61·45	61·79
May ..		52·31	55·95	57·37	58·90
June ..		47·73	52·15	54·32	56·09
July ..		45·09	50·03	52·21	53·86
August ..		48·90	51·10	52·14	53·36
September..		55·68	55·89	55·58	55·56
October ..		60·77	59·86	58·77	58·54
November..		61·92	62·57	61·65	61·04
December ..		66·47	65·40	64·08	63·39
1933					
January ..	Growth period	67·50	66·26	65·15	64·43
February ..		68·03	67·38	66·35	65·52
March ..		63·95	63·97	64·11	64·10
April ..		59·61	61·30	61·96	62·47
May ..		54·49	57·63	59·10	60·09
June ..		47·45	52·12	54·74	56·61
July ..		47·86	51·00	52·60	54·37
August ..		50·93	53·13	54·54	54·81
September..		54·92	55·14	55·68	56·00
October ..		61·08	60·20	59·47	59·02
November..		61·43	61·12	61·29	61·11
December ..		63·37	62·71	62·61	62·28
1934					
January ..	Growth period	64·58	64·26	64·09	63·69
February ..		63·62	63·94	63·98	63·94
March ..		62·13	62·64	62·90	63·23
April ..		58·77	60·44	61·16	62·21
May ..		52·80	55·54	57·60	59·91
June ..		48·64	51·53	54·57	56·91
July ..		46·98	50·29	53·46	55·27
August ..		50·22	52·23	53·34	55·05
September..		53·73	54·63	54·85	55·32
October ..		58·92	58·35	56·99	55·41
November..		60·09	58·86	57·93	55·65
December ..		62·44	—	61·88	—
1935					
January ..	Growth period	64·56	—	63·94	—
February ..		63·30	—	63·27	—
March ..		60·86	—	61·73	—

(5) From this study it is clear that each year there is *one* season of growth, *one* season of rest, and that periods of growth and rest do not sporadically alternate as they appear to do in trees of evergreen nature, in regions of the Union with less well differentiated warm-moist and cold-dry seasons.

As it is earnestly desired to know more about the *time* significance of rings of trees in the Union, in connection with climatological studies and plant succession, the results of the dendrographic observations above recorded are felt to be of some practical importance. Increment-borer and other checking and supporting methods are being given attention too, but the dendrographic method, in that it gives a continuous record of behaviour, sufficiently greatly magnified, is considered to be superior to any other so far used.

In connection with further work upon this important matter of nature of growth rings, and their indicator significance in connection with rainfall and other habitat conditions, I should mention that recently the dendrographic method has been applied to a widely spread indigenous tree, *Acacia caffra* (Katdoring; Kaffer wag 'n bietje), a tree deciduous in the greater portion of the cold-dry portion of the year, and therefore likely to show rings that are *annual.*

SUMMARY.

(1) MacDougal's dendrograph has been used for 3¼ years upon *Acacia melanoxylon*, an evergreen exotic, in the Witwatersrand area.

(2) Reversible variations have been exhibited.

(3) Permanent increment is shown to occur in well defined seasons, hence it is indicated that the growth rings, the so-called "annual" rings, are truly produced one per year.

(4) The significance of the annual nature of the rings, in connection with meteorological work, is mentioned.

(5) A diagram of a typical dendrogram is given.

REFERENCES.

MACDOUGAL, D. T.: 1918, 59; 1919, 72; 1920, 51; 1921, 1924, 1925 . . . . cited in PHILLIPS, 1927.

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